

# Nucleonica Newsletter

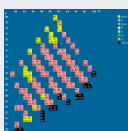
JANUARY 2013

ISSUE 2

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What's this photo?



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### Forum

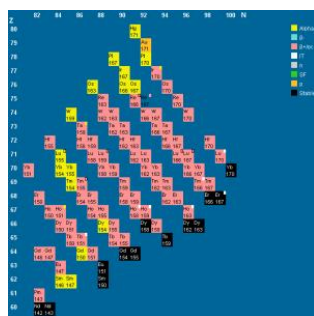
[www.nucleonica.com/forum](http://www.nucleonica.com/forum)



## An exciting year of operations!

*Dear Users,*

*In 2013 we enter our third year of operations – and we are still as enthusiastic about Nucleonica as we were 2 years ago. Not a single day passes without even more new ideas and challenges!*



*A special highlight in 2012 was the development of the new radiological transport assistant e-Ship through a collaboration with CERN.*

*This Newsletter outlines new technical developments on our online portal, an overview of the new 8<sup>th</sup> edition of the Karlsruhe Nuclide Chart published this year, as well as a review of training courses, exhibitions, conferences and meetings during 2012.*

*This Newsletter informs you about:*

**What's New in Nucleonica:** We are currently upgrading most of the Nucleonica applications with a view to improving user friendliness and calculation/response times. This means in practice fewer calls to the webserver and more emphasis on local client side computing. The first modules with these new features as well as all our further latest developments are described in this section.

**Karlsruhe Nuclide Chart:** The new 8<sup>th</sup> Edition of the Karlsruhe Nuclide Chart (KNC) was published mid-2012 and is now available. The new edition includes many newly discovered nuclides and updates in the nuclear data. We have also designed a new Auditorium Chart and work on the future 9<sup>th</sup> edition has already started. This section covers all the details about the KNC and its developments.

**Exhibitions, Conferences, Meetings 2012:** This section covers all exhibitions, meetings and conferences at which Nucleonica and the Karlsruhe Nuclide Chart have been presented in 2012.

**Training Courses:** A variety of Nucleonica training courses have been held during the course of 2012 and are reviewed in this section. Moreover, we announce upcoming training courses for 2013.

*We hope you will find this Newsletter helpful and informative and would like to thank all our customers for their support in 2012.*

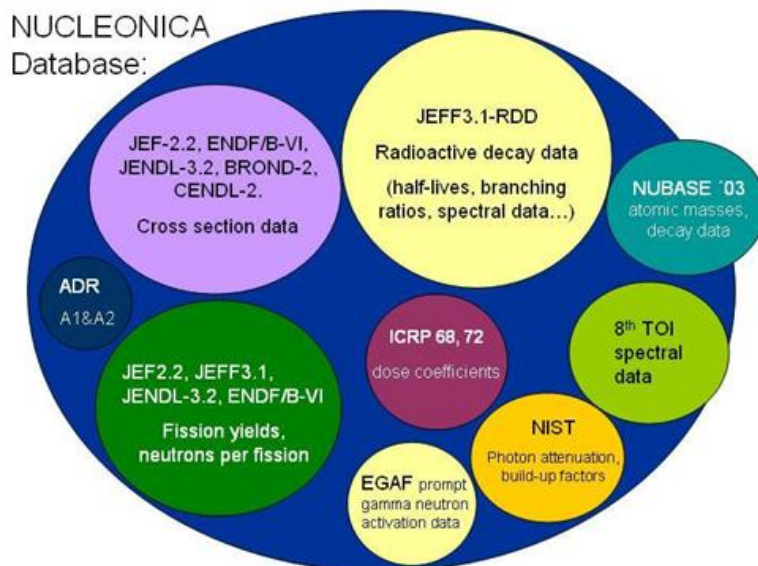
*Very best wishes for 2013*

*Dr. Joseph Magill  
Managing Director*

## What's New in Nucleonica?

### 1. Nucleonica Databases

What are the differences between the various databases used in Nucleonica? We are often asked this question with particular reference to JEFF3.1, 8<sup>th</sup> Table of Isotopes etc. The main nuclear data is contained in the Nucleonica database (see figure below).



This is based on the JEFF3.1 evaluated nuclear datafile, but with some corrections and improvements. The Joint Evaluated Fission and Fusion File (JEFF) project is a collaboration between NEA Data Bank member countries to produce a common set of evaluated nuclear data, mainly for fission and fusion applications. This database provides the full set of radioactive data required for many of the applications in Nucleonica such as dosimetry and shielding, decay calculations, gamma spectrum generation etc.

### 2. New Look Mass Activity Calculator

In 2012 we released a new version of the Mass Activity Calculator. Apart from cosmetic changes, two new tabs have been introduced: Options and Mixture details. In the Options tab the user can specify the distance from the source in the calculation of the gamma dose rate (default value is 100 cm). In the Mixture details tab, the user can now see the nuclide components and their masses, activities etc., when a mixture is selected. Previously, one had to go to the Nuclide Mixture module to see this information.

**Co60**  
10.47 m 5.27 y

**Mass Activity Calculator**  
**27 Cobalt**

Current Chart: Karlsruhe

Element: Co Mass: 60 Mixture selector

Calculator Options Mixture details

Quantity: 1E+06 Unit: Activity (Bq) Convert

Convert to:	Quantity
Mass (g)	2.388e-8
Activity (Bq)	1.000e+6
Activity (Ci)	2.703e-5
Number of atoms	2.400e+14
Mole of atoms	3.985e-10
Equivalent Gamma dose rate (µSv/h)	0.3370
Committed Effective Dose Equivalent, E(50)inhalation (µSv)	3.100e+4
Committed Effective Dose Equivalent, E(50)ingestion (µSv)	3.400e+3
Isotopic Power α (Watt)	0
Isotopic Power α+β (Watt)	1.548e-8
Isotopic Power α+β+γ (Watt)	4.161e-7

More information on the [Nucleonica Databases](#)

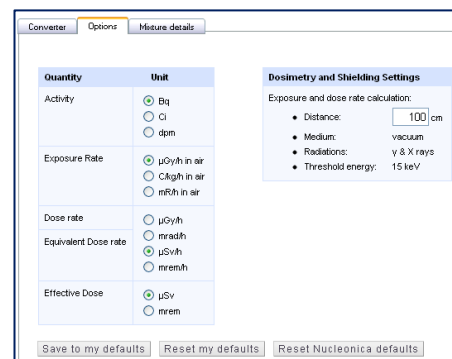
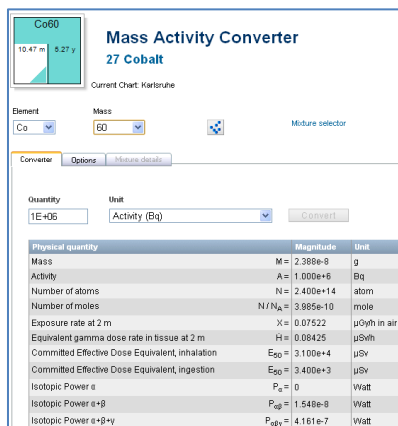
A 66-page colour brochure describing all the applications and features in Nucleonica is available. The [pdf](#) can be downloaded from our website

More information on the [Mass Activity Calculator](#)

More information on the [Mass Activity Converter](#)

### 3. New Mass Activity Converter

This new application – the Mass Activity Converter – is a completely redesigned version of the Mass Activity Calculator with more advanced features. The main tab now shows the physical quantities expressed explicitly as a number multiplied by a unit (see figure). Another new feature is that the user can now choose between SI units (Bq, Gy, Sv) and non-SI units (Ci, rad, rem, etc.). Due to its popularity, however, we continue to support the Mass Activity Calculator (see previous page).



More information on the use of [Nucleonica on Smartphones](#)

### 4. Nucleonica Applications on Smartphones and Tablets

Nucleonica can be used on smartphones and tablet devices. In a new wiki page we describe how Nucleonica can be set up and used on a variety of smartphones such as the Apple iPhone, Samsung Galaxy, etc. In a first step it is described how to create a Nucleonica icon on the home screen. Thereafter the website can be quickly accessed through the Nucleonica icon. The user can login to Nucleonica through the mobile login page to reach the nuclear science applications.



Most of the Nucleonica applications work on smartphones. There are some exceptions which require the use of plugins and these plugins are not yet available for the smartphone browsers. In the Data Centre, all modules work with the exception of the Universal Nuclide Chart (UNC). The UNC requires Java to be installed on the device. Currently, the iPhone does not support Java. The Virtual Cloud Chamber requires the CORTONA 3D virtual reality plugin. WESPA currently requires the Adobe Flash Player which is not available for all Smartphones.

More information on the Nucleonica wiki at [Decay Engine](#)

## 5. Decay Engine Upgraded

A new version of the Decay Engine – one of the most popular tools in Nucleonica – has been released. The application has been streamlined to improve the user-friendliness and ease of operation. There are now two modes of operation which can be selected in the Options:

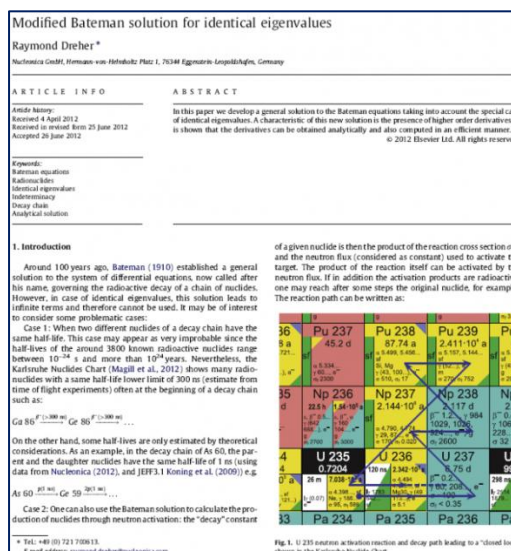
1. Time mode: For an initial activity of a given nuclide or nuclide mixture, the final activity is calculated after a decay time.
2. Date mode: if an activity is known at some time (date), then the activity can be calculated at any other time (date). In this date mode, the user can enter a date (e.g. when the sample was taken). The calculation result then shows the activity at any later time (date). This is useful for the calculations using standards and reference materials.

The screenshot shows the Nucleonica web application interface. At the top, there's a navigation bar with links: Applications, Data, Knowledge, My Preferences, Print, Networking, Nuclear Science, Help, and New Browser. The main header says "nucleonica ... web driven nuclear science". Below this, there's a section for "Decay engine" showing "27 Cobalt" and "Current Chart: Karlsruhe". There are input fields for "Element" (Co) and "Mass" (60), with a "Mixture selector" button. Below these are tabs for "Decay Engine", "Options", "Linear Decay Chains", and "Mixture details". The "Decay Engine" tab is active, showing "Time Unit" (Years), "Decay Time" (52.7101), "Starting quantity" (1.0000e+6), "Final quantity" (???), and "Unit" (Becquerel). There are "Start" and "Reset" buttons. On the right, a "Calculation details" box shows "Number of timesteps: 40", "Accuracy Factor: 0.01", "Distance (cm): 100", and "Number of linear chains: ???".

Other new features include: use of a slider control for easy reading of graphs, easier selection of nuclides or groups of nuclides for plotting, activation of features to be shown in the main tab, selection of quantities to be shown in the grid output, new decay "tree" manifestation of the decay processes.

An [important paper](#) by our colleague Raymond Dreher has just been published in the Annals of Nuclear Energy. In this paper Raymond reports a new solution to the Bateman equations for the case of equal eigenvalues (for example in cases where daughter products have the same half-lives). The solution has already been implemented in Nucleonica's Decay Engine for the calculation of radioactive decay chains.

Raymond Dreher, [Modified Bateman solution for identical eigenvalues](#), Annals of Nuclear Energy, 53, 427-438, 2013



## 6. Universal Nuclide Chart now with JEFF 3.1 data

The Universal Nuclide Chart (UNC) is a web-based nuclide chart in Nucleonica. In contrast to Nucleonica's Nuclide Explorer (which provides comprehensive nuclear data through links to the Datasheets), the UNC allows the user to simulate radioactive decay processes and isotope build-up in reactors through transmutation. This new version of the application is based on the JEFF3.1 radioactive decay data. The older version of the application was based on JEF2.2 data.



More information on the [Universal Nuclide Chart](#)

## 7. Dosimetry & Shielding Application upgraded

A new version of the Dosimetry and Shielding (D&S) application – a very popular tool in Nucleonica – has been released. In this new version, the daughter products can be accounted for simply through the use of a check box (highlighted in red in the figure). The user is then prompted to enter a decay time at which the daughter activities should be evaluated. Previously the user had to create a nuclide mixture containing the daughters before this could be used in the D&S application.

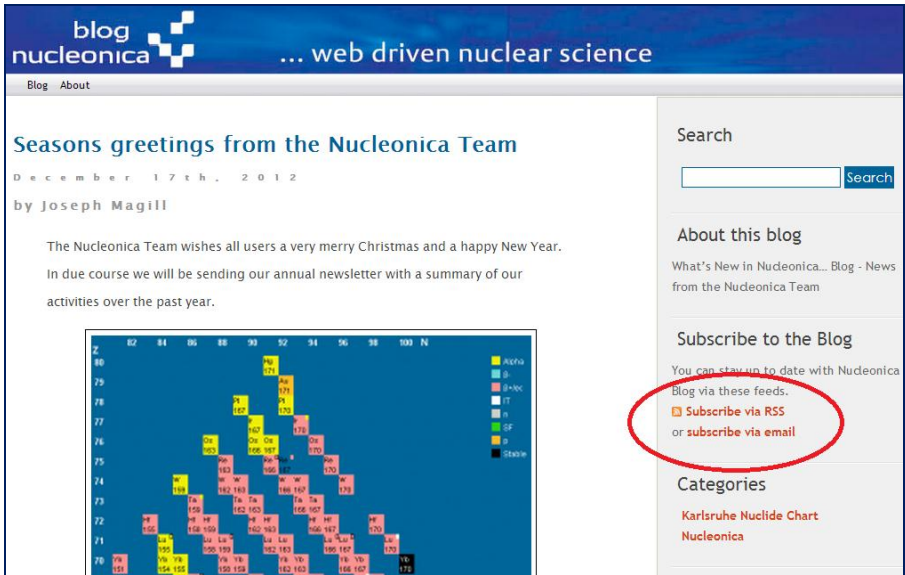
More information on the [Dosimetry & Shielding](#) application



**Blog**  
[www.nucleonica.com/blog](http://www.nucleonica.com/blog)

### 8. Receive Nucleonica Blog Posts via Email

This is a new service we are offering in which you can receive new blog posts directly to you by email. The service is based on Google's Feedburner. Just go to our blog page at <http://www.nucleonica.com/blog/> and click on "subscribe via email". As soon as a new blog article is posted, you will sent an email informing you of this.



More information on  
[e-Ship transport assistant](#)

### 9. e-Ship: new radiological transport assistant module

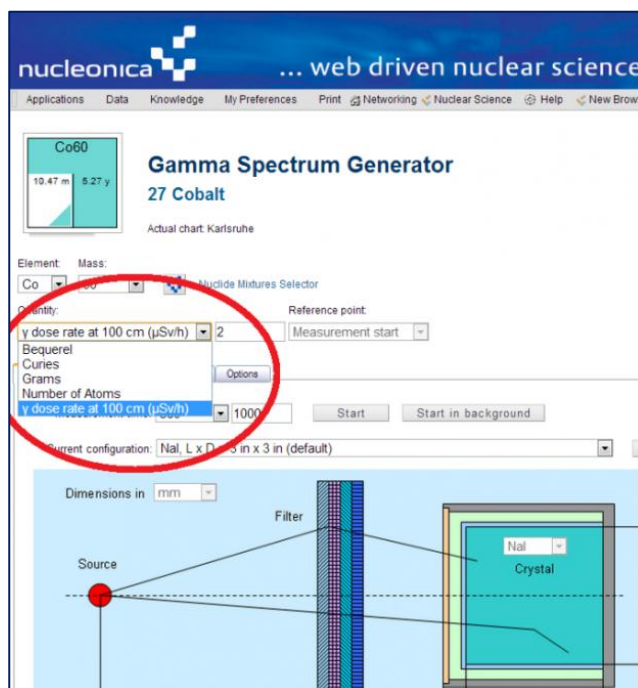
In 2012 a new radiological transport assistant module – e-Ship (electronic shipments) was released. The program assists the user to characterise packages for the shipment of radioactive material in accordance with ADR/IATA/IAEA transport regulations. This powerful new application has been developed through a collaboration between CERN and Nucleonica.



More information on the Nucleonica wiki at [Gamma Spectrum Generator](#)

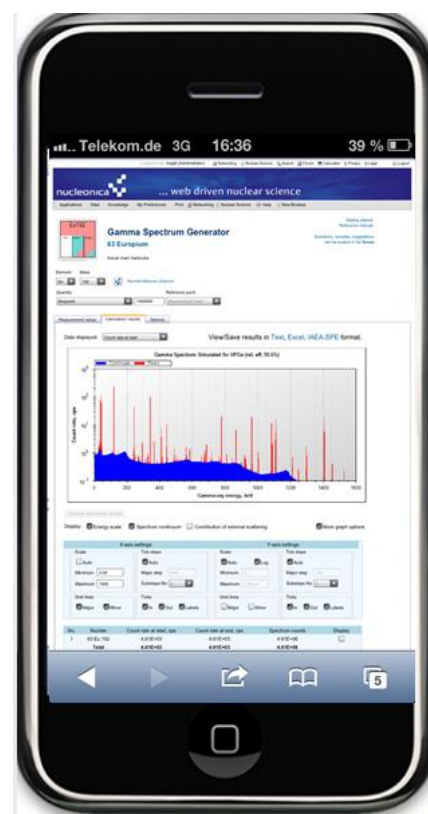
## 10. Upgraded GSG, GSG Pro

Following a request from the IAEA, the Gamma Spectrum Generator (GSG, GSG Pro) has been extended to allow the gamma dose rate as input in the calculations. For end users, the gamma dose rate is usually the quantity measured. The previous input quantities: activities in Becquerel or Curie, mass in gram, and the number of atoms have now been extended to include the gamma dose rate (see figure). The distance at which the dose rate is specified (1m in the figure) can be changed in the Options.



Following requests by our users, the Gamma Spectrum Generator (GSG) and GSG Pro results can now be downloaded in Excel format in addition to the .txt and iaea.spe formats.

Due to the rise in popularity of smartphones and tablets, and the gradual evolution of e(lectronic)-learning through b(lended)-learning to now m(mobile)-learning, Nucleonica has optimised many of its applications for use on such hand-held devices. Gamma spectra can now be generated directly on smartphones using the Gamma Spectrum Generator (GSG) application in Nucleonica. In the figure a gamma spectrum for Europium-152 is shown on the iPhone.





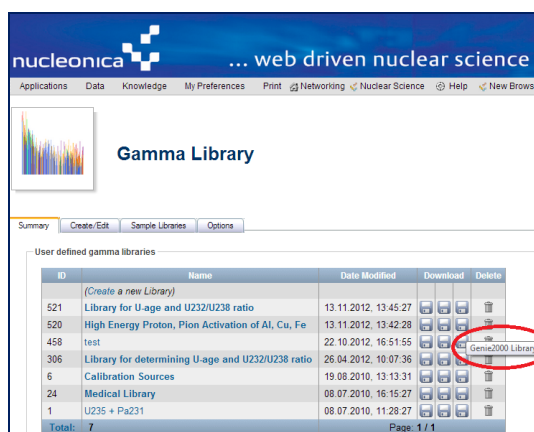
## 11. Nucleonica on Facebook

There is now a new Nucleonica page on Facebook to keep users up to date on the latest developments. The Facebook page is ideal for posting videos and photos. One recent video, for example, shows the interaction of high energy positrons with air in the presence of a magnetic field. Another video gives an announcement of the new edition of the Karlsruhe Nuclide Chart. We will also use the Facebook page to announce new blog and forum posts.



## 12. Nucleonica nuclide libraries in Genie2000 format

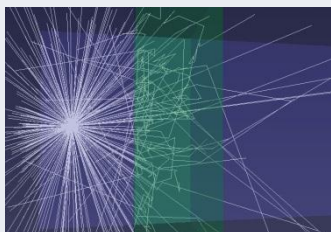
The Gamma Library application is a very user friendly tool for nuclide library creation using the up-to-date nuclear data available in Nucleonica. It is possible, for example, to create directly binary libraries for Ortec's GammaVision software. In a new development, it is now possible to create intermediate text-based files for Genie2000 libraries. A separate application is available which can then transform these text-based intermediate files to binary Genie2000 libraries (for information on this application please contact us at [info@nucleonica.com](mailto:info@nucleonica.com)).



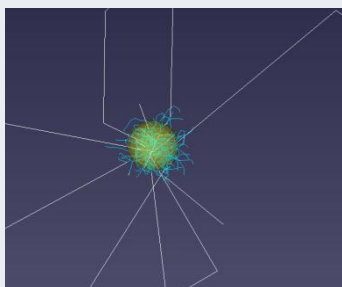
More information on the Nucleonica wiki at [Gamma Library](#)



### Nucleonica's Virtual Cloud Chamber...



**Multiple scattering:** low energy photons (energy 100 keV) are attenuated with a thick (15 cm) water shield. This combination of low energies and thick shields give rise to multiple scattering of the radiation



### Selective Internal Radio-Therapy (SIRT)

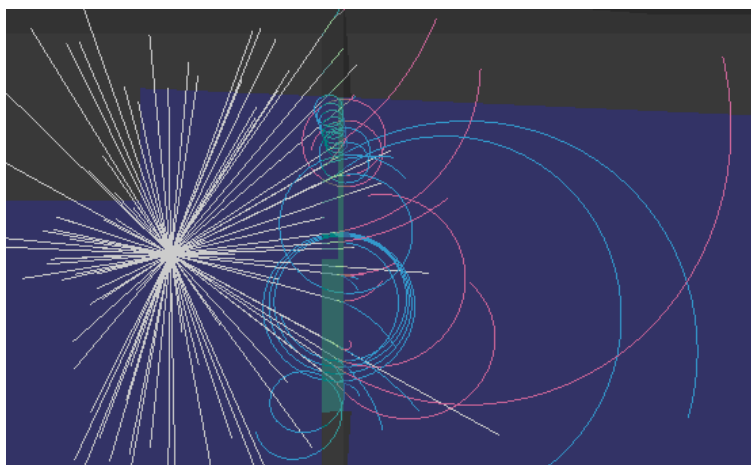
For the simulation electrons are selected and the energy is set to 2.28 MeV (2280 keV). The simulation media selected in water (since that is very similar to tissue). The source diameter is set to 1 cm - this highlights a volume of tissue corresponding to the range of the beta particles

[More information](#)

[Nucleonica's Virtual Cloud Chamber](#)

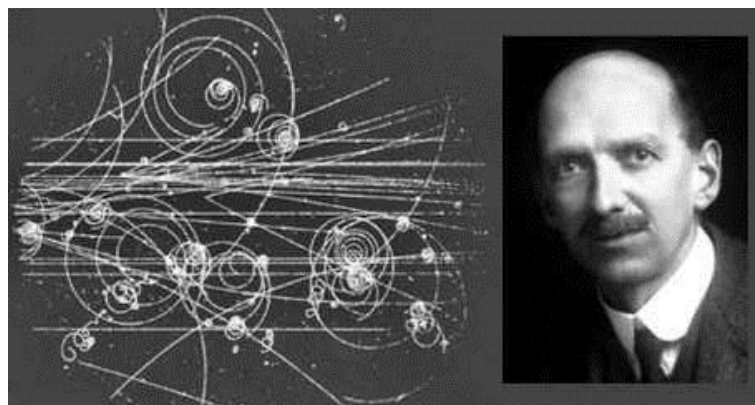
## 13. Virtual Cloud Chamber Animations

To coincide with the 100 year anniversary of Wilson's discovery of the Cloud Chamber, we have extended the Virtual Cloud Chamber to create animations. The animations can be viewed in any standard browser (Chrome, Firefox, IE), once the Cortona 3D virtual reality player has been installed. A typical animation of [positrons in a magnetic field](#) can be seen on our Facebook page.



Nucleonica's Virtual Cloud Chamber ([Play video](#))

Figure above: Nucleonica's Virtual Cloud Chamber - Electron-positron pairs are created through the interaction of 10 MeV gamma photons incident on lead. By "switching off" the electron and positron energy loss mechanisms, the charged particles are seen to spiral in the applied magnetic field. Information on the energies of the electrons and positrons can be obtained from the diameter of the trajectory in the magnetic field. Click on Play video to see the animation.



Courtesy Martin Frost

The cloud chamber was invented by the physicist CTR Wilson around one hundred years ago (1911 and 1912). Some testimonials include:

*—the most original and wonderful instrument in scientific history (Rutherford)*

*—The invention ... first revealed to the eyes of mankind the intimate details of the behaviour of the elementary particles of nature. (Blackett)*

Further information on the Karlsruhe Nuclide Chart can be found on the [Nucleonica website](#)

[Press Release](#) for the new 8<sup>th</sup> Edition

[Article](#) on the new edition in the German newspaper Frankfurter Allgemeine Zeitung (F. A. Z.) (10th August, 2012)

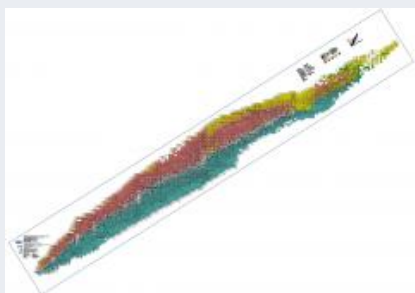
[Various versions](#) of the Karlsruhe Nuclide Chart...



The Karlsruhe Nuclide Chart Fold-out Chart (A4)



The Karlsruhe Nuclide Chart Wallchart (95 cm x 139 cm)



The Karlsruhe Nuclide Chart Auditorium Chart (43cmx316cm)

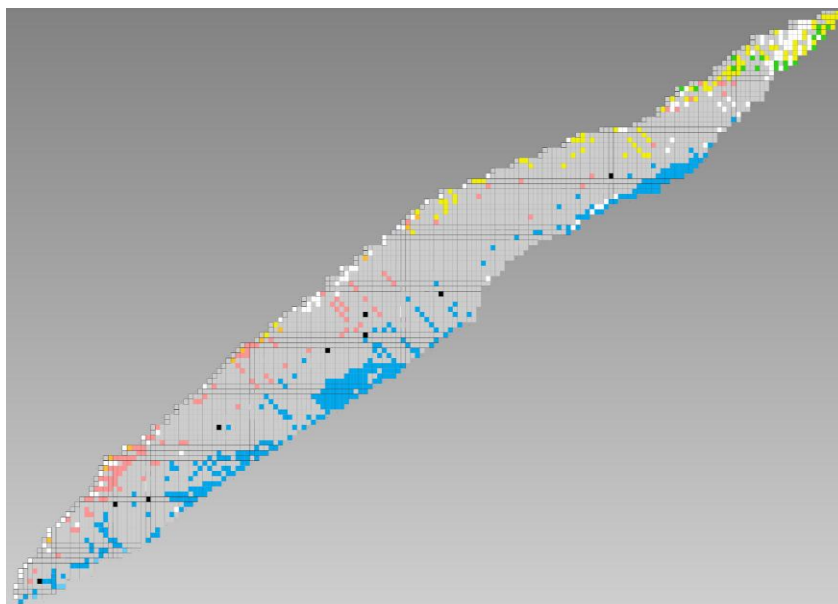
## Karlsruhe Nuclide Chart

The new 8<sup>th</sup> edition of the Karlsruhe Nuclide Chart was published in July 2012 jointly by Nucleonica GmbH and the Joint Research Centre, Institute for Transuranium Elements (JRC-ITU). New machine developments and improvements at major nuclear centres worldwide are the main source of discovery of new elements, isotopes and new experimental results. This very active area of research provides a continuous source of new data. Our mission is to maintain, develop and update the Karlsruhe Nuclide Chart with concise, up to date information on all experimentally observed nuclides. The 8<sup>th</sup> edition contains new and updated radioactive decay data on 737 nuclides not available in the previous edition, dating from 2006. In total, nuclear data on 3847 nuclides are presented. [Download the flyer.](#)



In addition, most recent values of the atomic weights, isotopic abundances and cross sections are included together with the thermal fission yields for both U-235 and Pu-239. New element names copernicium (symbol Cn, element 112), flerovium (Fl, element 114) and livermorium (Lv, element 116) have been introduced. As indicated in the "difference" Chart below, the new 8<sup>th</sup> edition contains information on the element 117 together with 193 new ground and isomeric states. New and updated experimental data on more than 544 ground and isomeric states are presented.

In the "difference" chart shown below, the coloured boxes indicate new and updated nuclides.



See also: [The New 8<sup>th</sup> Edition of Karlsruhe Chart of Nuclides: Description and Strategy](#) by Z. Soti, J. Magill, R. Dreher, G. Pfennig

The [New 8<sup>th</sup> Edition of Karlsruhe Chart of Nuclides](#) by Z. Soti, J. Magill, R. Dreher, G. Pfennig

Article on the new 8<sup>th</sup> Edition of the Karlsruhe Nuclide Chart published in Physics Today (Sept. 2012)

The new 8<sup>th</sup> Edition 2012 of the Karlsruhe Nuclide Chart is available as a "Carpet". Digital Print PVC: Polyester-Banner B1 with anti-slip laminate, Dimensions: 100 cm x 650 cm, ca. 2 mm thick. As an option your company's logo can be included on the carpet. If you are interested in obtaining this product for your organization please contact: [info@nucleonica.com](mailto:info@nucleonica.com)

The Karlsruhe Nuclide "Carpet" in CERN with CERN logo.

For its 50<sup>th</sup> Anniversary in 2013, the Institute of Transuranium Elements in Karlsruhe has obtained an even larger Carpet with size 1.5 m x 10 m.

Courtesy CERN 2012



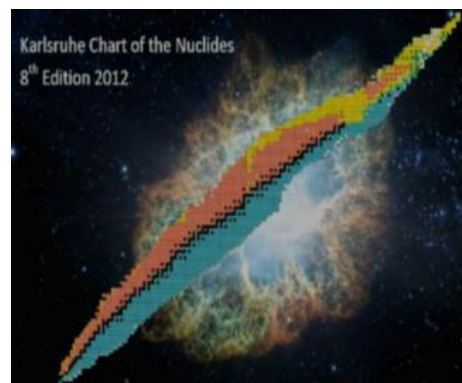
The Technical University of Munich (TUM) has a giant version of the Karlsruhe Nuclide Chart in one of the lecture theatres (shown). The Wallchart dimensions are 3.50 m x 2.52 m. Each nuclide box has a size of 35 mm x 35 mm (the original wallchart has a nuclide box size of 14 mm x 14 mm). In the photo, the nuclide chart is shown above the door to the lecture theatre on the right hand side.

Giant Karlsruhe Nuclide Chart (3.5 m x 2.52 m in the University of Munich, 2012). Courtesy Dr. Florian Kraus, Hans-Fischer-Hörsaal from the chemistry department of the Technical University of Munich.



A promotional video has been posted to YouTube showing the creation of nuclides in a supernova. The final screen shows all known nuclides in the Karlsruhe Nuclide Chart. The video was created by Gergely Söti.

[Play video](#)





## ***Exhibitions / Conferences / Meetings***

### **IRPA13**

Nucleonica was present with a stand (see photos below) at the IRPA13 in Glasgow. Approximately 1500 delegates took part in the conference. Of special interest was the schools event in which 1200 pupils from local schools participated. There was great interest in the nuclide carpet as can be seen from the photos. [more photos...](#)



### **TÜV Akademie**

The Nucleonica team gave a presentation at the meeting "New developments in radiation protection and their application in practice" held in Munich on the 11-12<sup>th</sup> June 2012. This conference is held annually and has firmly established itself with an attendance of about 140 participants. The program is aimed at scientists, engineers and technicians who are responsible in the field of radiation protection activities, and to authorities, experts and applicants in the nuclear licensing and supervisory procedures. The Nucleonica presentation was entitled "The program package NUCLEONICA: Generation of spectra for radionuclide mixtures".



### **Karlsruhe**

This exhibition took place in Karlsruhe on 23<sup>rd</sup> June 2012 and represented a first step in setting up a school project together with the Institute for Transuranium Elements (ITU) on: Radioactivity - a Life Saver. ITU and the European School Karlsruhe (ESK) worked on this together for the Karlsruhe project initiative "Stadt der jungen Forscher". The project results were presented at the "Wissenschaftsfestival" in June 2012 in Karlsruhe. Part of the project involved the use of Nucleonica by the students and teachers of the ESK.



European School Karlsruhe celebrates 50<sup>th</sup> Anniversary:

Pupils at the school dancing a "Nuclide Rap" on the large nuclide "Carpet" which can be seen on the floor at the bottom of the photo.

[Read article](#) (in German) in local press



### **Ljubljana 2012**

The Nucleonica Team presented a paper and a poster at the 21<sup>st</sup> International Conference on Nuclear Energy for New Europe – Ljubljana 2012:

[Nucleonica: Web-based Software Tools for Simulation / Analysis](#) by J. Magill, R. Dreher, Z. Soti, G. P. Lasché

The [New 8th Edition of Karlsruhe Chart of Nuclides: Description and Strategy](#) by Z. Soti, J. Magill, R. Dreher, G. Pfennig



### **Munich**

A meeting of the GRS (Gesellschaft für Anlagen-und Reaktorsicherheit) and Nucleonica teams took place on 8<sup>th</sup> November at the GRS headquarters in Munich. The aim of the meeting was to discuss potential areas of collaboration. Of particular interest was the subject of knowledge management underlying program code development. The GRS expertise in reactor physics and Nucleonica's expertise in web-based scientific applications are complimentary for sustainable code development. A collaboration agreement for future joint developments is under preparation.

## ***Training Courses***

### **Core Capabilities in Nuclear Forensics, 16-20 April 2012**

This meeting took place at the KIT centre in Karlsruhe. The course was arranged through the European Nuclear Security Training Centre (EUSECTRA) and involved approximately 15 participants from South East Asian countries including Malaysia, Indonesia, Philippines, Thailand, Singapore and Vietnam. The training course also involved practical work at the Institute for Transuranium Elements. A general introduction to Nucleonica was given together with a number of applications on the use in the context of nuclear security.



### Training Courses 2013!

Participating in a Nucleonica training course is the most effective way of learning to use Nucleonica. The next Nucleonica training course is planned for 18-19 April 2013 in Karlsruhe

### Are you interested?

Please contact us at:  
[info@nucleonica.com](mailto:info@nucleonica.com)

Information on future training courses will also be posted on the Nucleonica web site at [Nucleonica Training Courses](#)

The full training course proceedings are available [online](#)

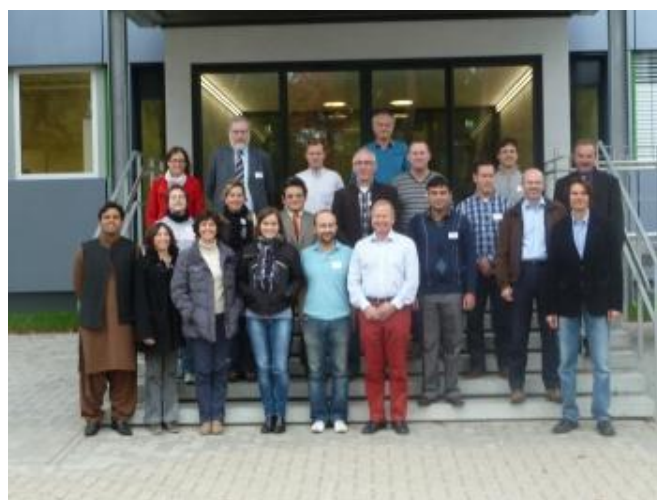
For further information see [Nucleonica Premium Access](#)

### Introduction to Nucleonica: Core Applications and Tools, 2-3 July, 2012

This 2-day training course took place at the WAK site HDB (Hauptabteilung Dekontaminationsbetriebe) on the KIT Nord Campus during the 2-3 July, 2012. This was a dedicated training course for WAK/HDB staff which focused mainly on decommissioning and characterization of nuclear waste. In total, 11 WAK/HDB staff members took part in the course. Guest speakers included Drs. Z. Soti and J. Zsigrai from the JRC/ITU in addition to Dr. J. Magill and Mr. R. Dreher from the Nucleonica team.

### Introduction to Nucleonica: Core Applications and Tools, 25-26 October, FTU-KIT, Karlsruhe, 2012

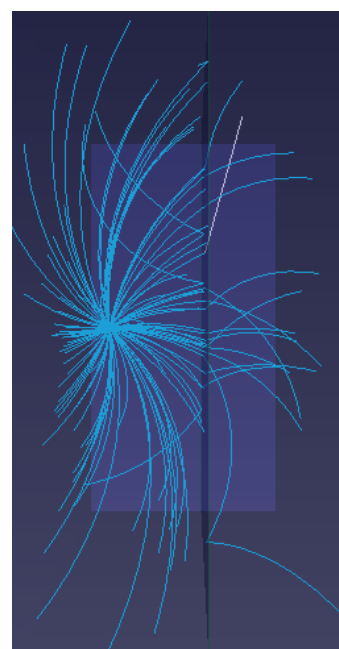
This 2-day training course took place at the Center for Advanced Technological and Environmental Training FTU, Karlsruher Institut für Technologie (KIT), during the 25-26 October, 2012. In total, 18 persons took part in the course from the



Royal Netherlands Air Force (Netherlands, 4), Pakistan Nuclear Regulatory Agency (IAEA/Pakistan, 2), CERN (Switzerland, 4), Institute for Transuranium Elements (Germany, 5), Joint Research Centre Geel (Belgium, 1), Karlsruhe Institute of Technology (Germany, 1), Helmholtz München (Germany, 1).

### Nucleonica training course in Berlin

This one-day training course for staff at the Federal Office of Radiation Protection (BfS) was held in Berlin on 21 – 22 Nov. 2012. The special focus in this course was on the use of the “standalone” version of Nucleonica. This Standalone version of Nucleonica is ideal for use in mobile labs, field work etc. and other locations where an internet connection cannot be assured. This version is based on virtualisation technology and on the use of a virtual server. The whole package comes on a DVD. The program is then installed on the notebook computer. It is also very fast - each user has his/her own virtual server!



## Careers

Nucleonica is a rapidly growing internet portal delivering nuclear data and web-based nuclear science applications to our users worldwide. We are looking for scientific software developers with a science and engineering background, who would like to grow with us, who share integrity, intellectual curiosity and the desire to work in a collegial atmosphere with like-minded people. Nucleonica offers full and part time jobs.

You should have programming experience in at least one of our core languages: Java, Javascript, C#, C++, C, VB, .NET, or Python.

Internships are available to undergraduate and advanced degree students throughout the year. We are also open for collaborations and meeting potential partners.

If you would like to apply, simply send us your CV and cover letter by email to [info@nucleonica.com](mailto:info@nucleonica.com).

Nucleonica GmbH is a spin-off from the JRC's Institute for Transuranium Elements



## Thank you!

Nucleonica GmbH would like to thank everyone who has contributed during 2012. Special thanks go to Prof. Dr. Thomas Fanghänel, the Director of the Institute for Transuranium Elements (ITU), for his interest and continued support of ITU's first spin-off company.

Special thanks also go to the Technology Transfer Unit of the JRC in Brussels for assistance during the past year.

Thanks also to Mr. Yann Donjoux from CERN for a very successful collaboration in the implementation of CERN's radiological transport assistant *e-Ship* as a web-based application in Nucleonica.

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In 2012 Nucleonica has made donations to SOS Kinderdorf and Médecins Sans Frontières.



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